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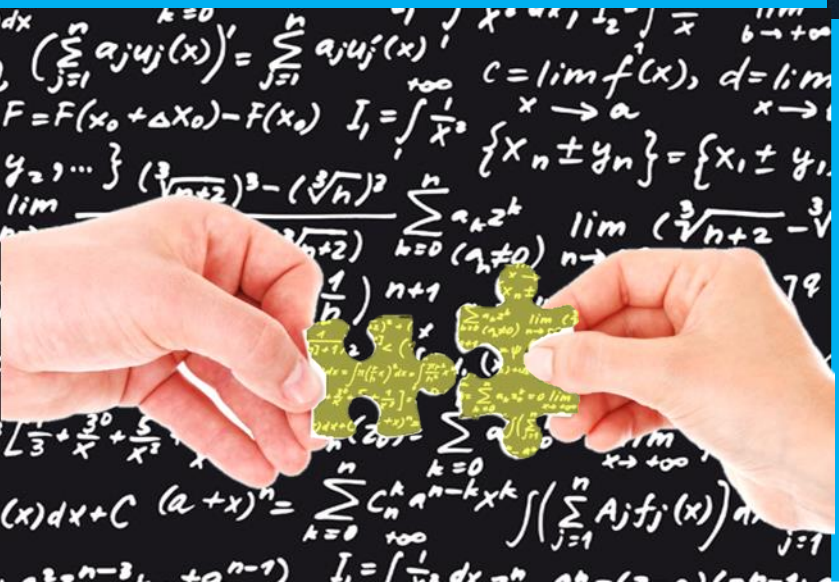
Is world trade becoming more regionalised?



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ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE

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ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE

WORKING PAPER

Is world trade becoming more regionalised?

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Abstract

The proliferation of RTAs is a central feature of the world trade policy environment in the last 20 years. This paper provides an empirical study of the extent to which the formation of RTAs has changed the distribution of world goods trade among trading partners. To do this, it constructs a new measure, an index which measures the extent of bilateral trade between pairs of countries in each year. On average for the world economy this measure does not increase over the sample period 1981 to 2016. To study the impact of RTAs on the pattern of bilateralism in detail, we use a fixed effects regression model of countries for a panel dataset for countries in the Asia Pacific region. The evidence that the proliferation of RTAs has changed the country distribution of world of trade is very weak.

Keywords: bilateralism, Index of bilateralism, RTAs, Asia Pacific region

JEL Codes: F10, F14

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1. Introduction

There has been a consensus among trade economists that regional trading arrangements have become steadily more important in world trade over the last two decades or so. Since the 1990s the world has seen a rapid and sustained formation of regional trade agreements (RTAs), making regionalism the most active mode of trade liberalization. Globally there are 274 RTAs in force of which 62 per cent (170) involve Asia-Pacific economies (ESCAP, 2017).

However, there is a question as to how much the rapid growth in the number of regional trade agreements in the last 20 years or so has actually changed the pattern of world trade (see, for example, Medvedev (2010), World Trade Organisation (2013, 2016) and Michaely (2014)). There is no definitive answer to this question. There are several reasons for this lack of clarity. It is not clear how trade-liberalising recent RTAs have been as the provisions are, in many cases, complex and backloaded in time. Rules of origin are trade-restricting in all RTAs. Another complication is that preferential access gained by one country into the markets of one or more other countries is often eroded by other countries gaining preferential access to the same markets under other trade agreements.

In this trade policy environment, it is important to understand shifts in the pattern of international trade. Trade between countries is, by definition, bilateral trade. We examine international goods trade patterns by constructing an index of the extent to which international trade has become more bilateralised in the sense that nations tend to source imports from the same countries to which they send their exports. This study contributes to the existing literature on regional trade by introducing the Index of Bilateralism to measure the extent of two-way flows of goods trade, and then applies this measure to the analysis of the effects of RTAs in the Asia-Pacific region.

In its form, the measure of bilateralism is the same index as the Grubel-Lloyd index of intra-industry trade. In the present application of this index, however, we consider the distribution of one country's exports and imports by country rather

than by industry. This is done at several levels (the measures used are developed in the Appendix).

First, we measure the extent of bilateralism between a country *j* and a trading partner country *k*, using the index G_{jk} for the country pair (*j, k*). This shows the proportion of the total trade between the pair of countries which is matched. Since we distinguish between country pairs that do have an RTA in force in each year and those which do not, this index provides a new measure to test the hypothesis that the formation of bilateral reciprocal trading agreements changes the distribution of the countries' good trade. Second, we aggregate the matching trade of country *k* with all of its trading partners, using the Index G_j for the country *k*. This measure captures the extent to which a country's exports to each of its trading partners match its imports from the same country. Third, we aggregate these measures across all countries to obtain a measure of bilateralism in global trade.

The justification for the use of bilateralism measures is that we expect the formation of a bilateral trade agreement to increase trade in both directions simply because it is a reciprocal agreement which each country has signed in the expectation of an increase in its exports to and its import from its trading partner. There is no necessity that trade between the pair will become more balanced as captured by the measure G_{jk}. In particular, if one of the trading partners is much larger and dominant, an agreement might favour the dominant partner disproportionately. (This is an empirical matter, despite the theory suggesting that the smaller partner would benefit more). However, because the improved market access resulting from the agreement is mutual, there is a presumption that the formation of reciprocal trading agreements will generally induce an increase in our measure of bilateralism.

To examine the effect of RTAs on the level of bilateralism, we then use the indexes among economies in the Asia-Pacific region. The finding suggest that the level of bilateralism is positively associated with an active RTA in the case of plurilateral agreements but not in bilateral agreements. Other factors that positively influence

the level of bilateralism include the total size of trade within an RTA and share of RTA trade in total trade of RTA members.

2. The indexes of bilateralism

In 1975, Herbert Grubel and Peter Lloyd introduced what became known as the "Grubel-Lloyd Index" as a measure of the extent to which one country's good trade consists of exports and imports of goods of the same "industry" which match each other. Following this approach, Subramaniam and Kessler (2013) produced what they called the *Grubel-Lloyd Index of Two-way Foreign Direct Investment Flows*. This is an index measuring the extent to which foreign direct investment (FDI) flows between countries "criss-cross" each other.[1] Applying the Grubel-Lloyd Index to FDI flows, Subramaniam and Kessler (2013) find that the proportion of matching flows rose steadily from the early 1970s to about 2000 and has plateaued since then. This finding raises the question of what has happened to the extent of matching of inter-country flows of goods over this time period. The original Grubel-Lloyd index can be applied to the distributions by trading partner of a country's exports and imports. Have this risen similarly?

This paper proposes a Grubel-Lloyd Index to measure bilateralism in world trade. The index is calculated in the following way. Take one country, *k*, in one year. Let I_{jk} and E_{jk} denote the imports of goods from and the exports to one other country, country *j*, respectively and let I_k and E_k denote the total imports and exports respectively of country *k* from all sources and to all destinations. We calculate the

[1] However, this index as it is used in Subramaniam and Kessler (2013) does not examine bilateral investment flows. They merely measure the extent to which the FDI inflow of a country from the world is matched with an outflow from that country.

Curiously, at the country level, the same measure as we use for the analysis of bilateralism for country pairs was applied in some studies to the breakdown of a country's total trade imbalance (deficit or surplus) into bilateral balancing and multilateral balancing during the Great Depression of the 1930s. (See Grubel and Lloyd (1975, pp. 12-13)). Beginning in 1933, the League of Nations published a number of studies quantifying the extent to which countries balanced their goods trade bilaterally or multilaterally during the Great Depression. The motivation of these studies was, however, different in this period. At that time countries engaged in bilateral trade agreements in order to overcome the adverse effects of exchange rate uncertainty and other countries' beggar-thy-neighbour trade restrictions.

value of imports which is matched by exports and then normalise this by dividing by the sum of the value of exports and imports between countries *k* and *j*. Then the Index of matching import flows/export flows between the pair of countries *j* and *k* is

$$G_{jk} = 2 \min (I_{jk} , E_{jk}) /(I_{jk} + E_{jk}) \quad (1)$$

This measure can be called the Index of Bilateralism in Goods Trade between Country *k* and Country *j*.

This is the primary form of the index used in this paper. It is applied both to country pairs which have a bilateral RTAs and to other pairs in the same manner and it can be extended to a group of more than two countries which formed a RTA, as in the case of the European Union (EU) (see Appendix). In all cases it measures the extent to which trade between the countries is matched. The Index can take values between 0 and 1. An index of 0 denotes that a country's exports and imports are perfectly unmatched—that is, a country is either wholly an importer or an exporter of goods in its trade with this country. An index of 1 denotes that a country's exports and imports are exactly matched—that is, a country exports and imports to a certain trading partner are equal in value.

For one country, the second form of the index measures the matching of one country's trade with all of its trading partners. This is done by summing the matching trade of country *k* with each of its trading partners countries and expressing this as a proportion of the total value of country *k*'s exports and imports. We call this measure, G_k, the Index of Bilateralism in Goods Trade for Country *k* (Equation A.3 in the Appendix).

The third form of the Index is a measure of the extent of bilateral matching of exports and imports across all countries. This is done by summing the matching trade of all pairs of countries and expressing this as a proportion of the total value of world exports and imports (Equation A.4 in the Appendix). We call this the Index of Bilateralism for Global Goods Trade, G.

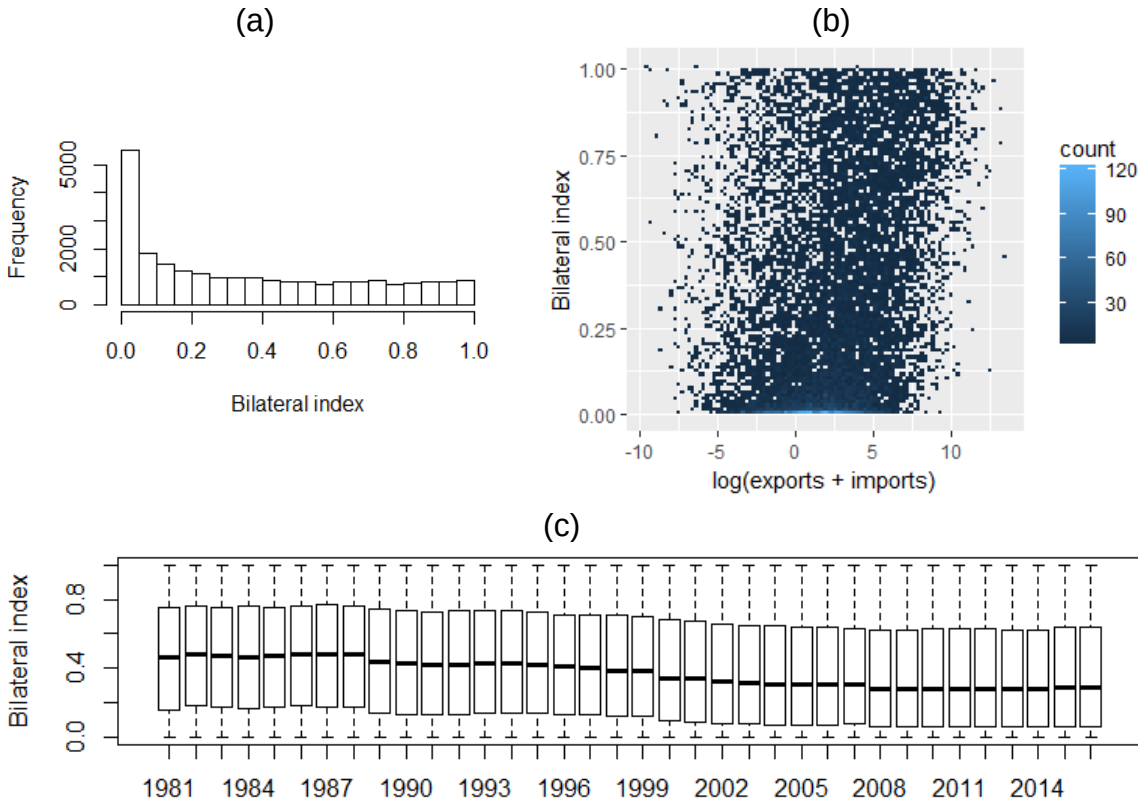
To examine the trend in the level of bilateralism in global trade, we calculate from the panel dataset indexes of bilateralism for individual pairs of countries, for individual countries and for the world as a whole in each year over the period 1981-2016. The bilateral trade data is taken from the International Monetary Fund's *Direction of Trade Statistics* (DOTS) database for this period. As exports and imports are measured differently (fob and cif), to ensure that pairwise indexes were identical, bilateral export values was derived by mirroring bilateral imports. Next the indexes are calculated for flows of good trade following the method described above.

3. Indexes of bilateralism for country pairs

The index is calculated initially for the bilateral trade of 35,455 pairs in 2016. Given that mirrored data was used, the indexes between the pairs of countries are identical for the reporter/partner combinations.

A large proportion (32 per cent) of the calculated values of the index are recorded as zero. There are several reasons for this result. First, many of the bilateral trade relationships including a small economy are one-sided. For example, Faroe Islands is recorded to have 198 bilateral trade relations (whether just imports, just exports, or a combination of exports and imports from/to partners). From those, 191 have imports of greater than zero, and only 81 have exports greater than zero, culminating in non- zero bilateral index for just 74 out of 198 trade relations. Other general categories, such as "Western Hemisphere not allocated" and "Europe not allocated" also have high incidence of zero valued bilateral index.

Figure 1. Distribution of the bilateral Index for all pairs

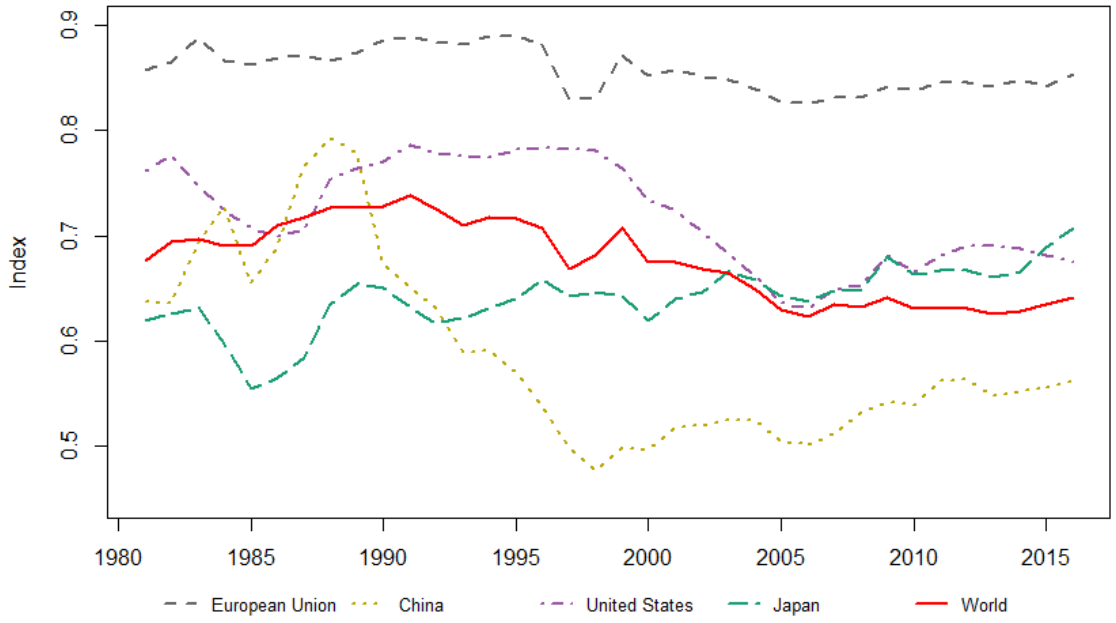


Source: Authors' calculations based on IMF DOTS data.

When the instances of a zero-valued bilateral index are removed, the distribution still shows a large left-side skewness (figure 1a). This skewness is only weakly explained by the size of bilateral trade (R^2 = 0.07): for the most part the bilateral index is independent of the size of bilateral trade between a pair of countries (figure 1b). Across the years, the whole distribution of bilateral indexes declined somewhat after the mid-1980's before plateauing after 2008 (figure 1c).

The series of values of the Index of Bilateralism for Global Goods Trade is plotted in figure 2 as the bold line. There is no trend. The global average at the beginning and end of the sample period, 1981 and 2016, were 0.68 and 0.64, respectively. The global index decreased after the early 1990's to its lowest level in 2005, before plateauing.

Figure 2. Indexes of bilateralism - the global index and country level indexes for the big four[2]

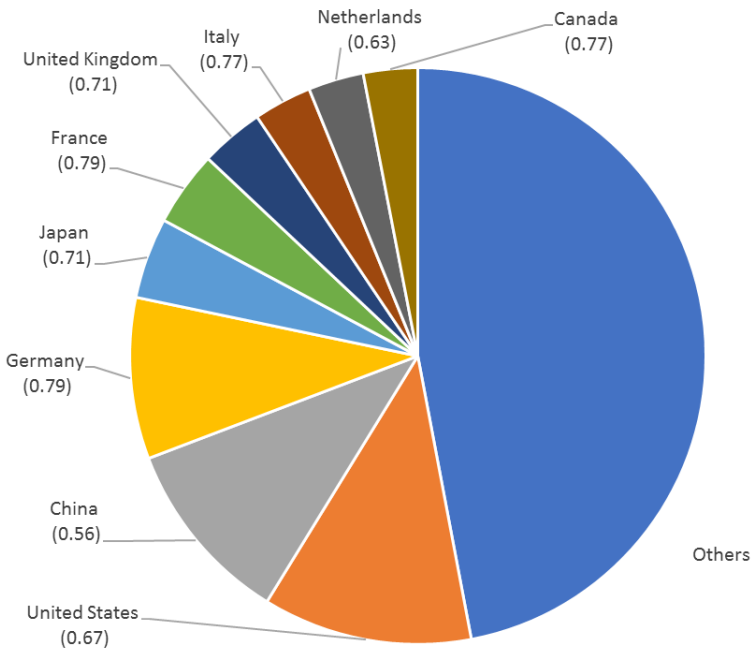


Source: Authors' calculations based on IMF DOTS data.

As the global-level index is weighted by the relative value of the trade of each country (see the Appendix), it is worth examining which economies contribute the most to the index. The top 9 countries with the largest weights and their respective Indexes of bilateralism for all trading partners are presented in figure 3. Note that these range from 0.56 (China) to 0.79 (France and Germany), and the top 9 together account for over 50 per cent of the weight, resulting in the value of global bilateralism of 0.64 in 2016. For the top 9 weights, only China and Netherlands are below the global average.

[2] Note that the world average in figure 2 is the arithmetic mean, with the number for each pair weighted by their contribution to world trade, whereas the world average in figure 1 (c) is the median. The mean is consistently higher than the median because the values of the index for the Big Four countries in particular are above the median value in each year.

Figure 3. Composition of bilateralism in 2016 by economies and respective weights



Source: Authors' calculations based on IMF DOTS data.

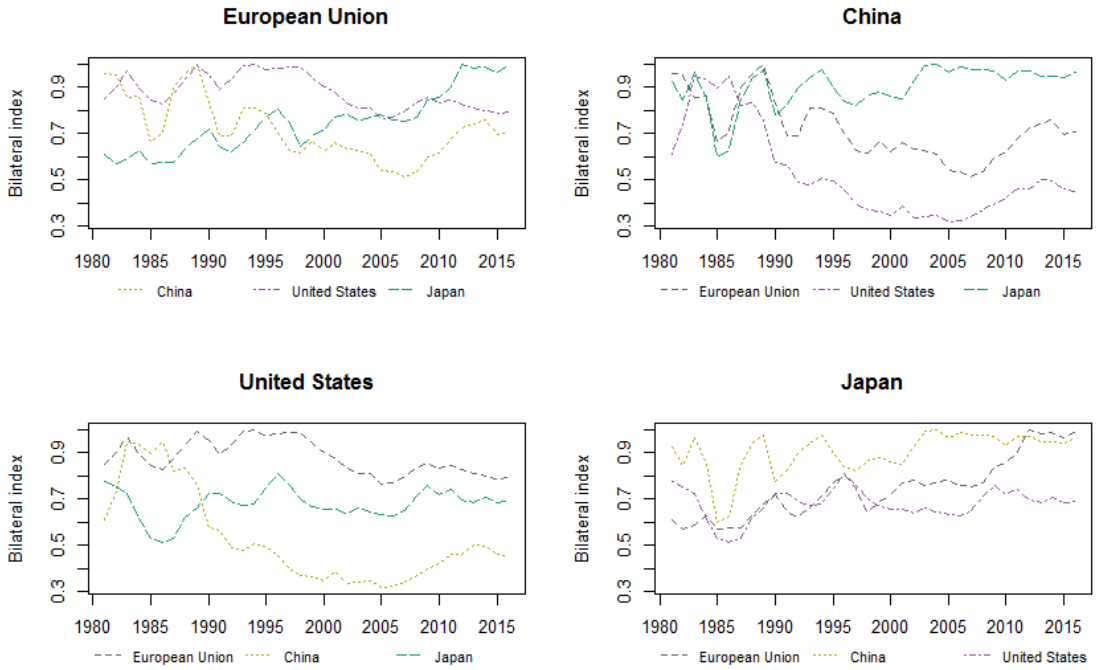
Next, we look at the bilateral trade relationships for the world's four largest trading countries or trading group, the Big Four (European Union, China, United States and Japan). Bilateral relations among the Big Four are important. Alone they are a significant part of global trade, accounting for 60.5 per cent and 60.3 per cent of global trade in 1981 and 2016, respectively and figure 3 showed that these countries also have a large weight in determining the Global Index of bilateralism. Moreover, prior to the conclusion of the agreement between the EU and Japan in 2017, there had been no bilateral or plurilateral RTAs between any of the 6 pairs involving these counties or groups. This makes them an interesting sample to compare with country pairs that do have an RTA.

The index for each of the Big Four across all trading partners are reported in figure 2. The European Union has a much higher average level of bilateralism in its trade with individual countries than the other three. China has the lowest levels for most of the period and it fell dramatically from late 1980's to late 1990's, before

rebounding. The United States and Japan are above the global average after the early 2000's and they have converged since that time.

Now we examine the bilateral indexes for each of the pairs in the Big Four. As noted above, this is an important sample of the bilateral indexes between countries or country groups that do not have an RTA in force. The values of these indexes for each of these six pairs are graphed in figure 4. (The series for the index for each of the pairs appears twice in the figure as $G_{kj} = G_{jk}$; for example, the series for the US-China trade appears in both the graph for china and that for the US.) For the EU, the US and China the values of their bilateral pairing indexes are distributed around the Global Index for corresponding years. China had high trade matching with the United States up until early 1990's, before declining significantly until 2005, when matching rebounded. This was the period when the US had large deficits in its goods trade with China. China's trade with Japan seems to be have had a consistent matching ever since the early 2000's. China's matching trade with the European Union stayed approximately equal between that with the United States and Japan. In comparison, United States has highest trade matching with the European Union and the lowest with Japan. In contrast, the value of the indexes for trade by Japan with each of the other three are consistently above the value of the Global Index for corresponding years. Because of the choice of these pairs, none of the differences can be explained by the formation of RTAs.

Figure 4. Grubel-Lloyd index of bilateralism for pairs among the four largest trading economies



Source: Authors' calculations based on IMF DOTS data.

At the level of trade between country pairs and at the level of the average for each country, there is considerable year-to-year variability in the calculated value of the indexes. At the global level there is much less annual variability because of the offsetting among the measures for individual countries.

4. Explaining the levels of bilateralism over countries and time

We now seek to explain the very wide distribution of the index numbers of bilateralism among country pairs and the trends over time observed in the previous section.

Most of the discussion on changes in the pattern of global trade has centred on the rapid and sustained formation of preferential trade agreements since the early

1990s.[3] We use the existence or otherwise of an RTA between a pair of countries as the preferred binary variable to explain the variation in the measured levels of bilateralism across countries and time.

The null hypothesis is that entering into an RTA increases the Index of Bilateralism in Goods Trade between country pairs, holding constant other factors which co-determine levels of bilateralism. However, it is possible that entering into an RTA decreases the Index.[4] This possibility seems counterintuitive. It can be explained by looking at how the Index is calculated. To recall, the Index measures the proportion of goods trade flows which consists of imports to one country that are matched by exports from the same country. A decrease in the Index does not mean that trade between two countries (or a group of countries) has decreased, but rather that the trade flows are less balanced between the two trading partners. Trade flows from one country to another country increase more than the reverse flow. Consequently, the sign of the RTA variable is uncertain *a priori*. Other factors also influence the measured levels of bilateralism.

The following sections use empirical data on trade flows and RTAs in Asia and the Pacific to conduct an analysis of the effect of entering into an RTA on bilateral trade in the region. Countries in East Asia and some others in the Pacific were relative latecomers in the movement to form RTAs but the rapid spread of RTAs in the region in the present millennium has meant that countries in the Asia-Pacific region now account for 62 per cent of the RTAs currently in force globally; most of these trade agreements are bilateral (81 per cent) (ESCAP, 2016). For this reason,

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[3] In addition to reciprocal preferences granted under PTAs, there are non-reciprocal preferences granted to Developing Countries or to Least Developed countries under a variety of schemes: GSP systems operated by some Developed countries, the EU's EBA Agreement, the US African Growth and Opportunity Act and other schemes. Non-reciprocal preferences are much less important in world trade than reciprocal preferences and their extent has probably not increased as rapidly since 1990. In fact, WTO (2011, p. 76) found that "… about 80 per cent of preferential trade takes place under *reciprocal* preference regimes…" (emphasis added).

[4] The third logical possibility that entering into an RTA has no effect on the level of bilateralism holds with a probability approaching zero.

the population of countries in the Asia-Pacific region is used as a sample to try to explain the observed pattern of bilateralism.

The gravity model has been widely used in empirical studies of inter-country variation in various aspects of bilateral trade flows. In the present context, it can be used to try to explain inter-country variation in the measure of bilateralism between pairs of countries. Following recent practice, one can specify a range of explanatory variables, including distance and GNP as well as the existence of an RTA between each pair of trading countries.

We use a fixed effects regression model to study the impact of RTAs on the behaviour of the indexes. The dependent variable is the Index of Bilateralism in Goods Trade between a pair of countries or group of countries[5] in the Asia-Pacific region. Time series are calculated for the years from 1981 to 2016. The key explanatory variable is the dummy variable for the years an RTA was enforced ("RTA in force").[6] Control variables include year and RTA fixed effects, the size of total trade among RTA members ("log (RTA trade)"), total trade under a RTA as a share of total trade of signatories ("RTA trade share"), and the index of trade dominance ("$\overline{H}$ Index"). The $\overline{H}$ Index is a modified normalized Hirschman index, which measures the trade size of countries in an RTA in relation to the total trade of the countries in an RTA.[7] An $\overline{H}$ Index of close to one implies that one country is highly dominant. For example, the $\overline{H}$ Index in the Japan-Mongolia case is 0.98, as Japan has by far the larger total trade among the two countries. In contrast, the $\overline{H}$ Index for Australia-Singapore Free Trade Agreement is 0.01, meaning that the total trade size between the two countries is very balanced.

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[5] When more than two countries are involved in one regional trade agreement, the inter-country flows are aggregated across the group, as in the form of the index for a group of countries reported in Equation (9).

[6] Taken from ESCAP (2017). APTIAD database is available from http://www.unescap.org/content/aptiad

[7] $\overline{H} = \frac{\sum_{i=1}^{N} s_i^2 - \frac{1}{N}}{1 - \frac{1}{N}}$ where s_i is the share of an economy i's total trade of the total trade of N economies in an RTA.

5. Results and analysis

Table 1 presents the results of the various specification of the model for the full sample of 5,273 Indexes for the bilateral trade between two countries. In regression 1a the negative sign on the dummy variable for the years in which an RTA is in force suggests that having an RTA actually decreases the level of bilateralism. However, the model has very weak explanatory power ($R^2 < 0.001$). Controlling for year fixed effects the variable RTA-in-force is no longer significant (model 2a). This implies that the RTA-in-force dummy variable is picking up the fact that most RTAs have been signed relatively recently in the sample period, and this variable is picking up the time trend. Adding RTA-specific fixed effects increases the explanatory power of the model but decrease the significance of the RTA-in-force variable (model 3a). The size of bilateral trade ("log (RTA trade)") in model 4a suggests that the size of bilateral trade is positively associated with the level of bilateralism: a 1 per cent increase in the level of bilateral trade increases the bilateralism index by 0.036. Furthermore, the share of RTA trade in RTA members' total trade is also shown to be highly significant, suggesting that trade is more balanced when the share of RTA trade is higher: a 1 percentage point increase in the RTA trade share increases the level of bilateralism by 1.22/100 = 0.0122. Contrary to *a priori* expectations, increased trade dominance by larger traders party to a RTA as measured by the $\overline{H}$ Index is associated with higher level of bilateralism, implying that smaller economics are not being taken advantage of by larger economies (6a). Furthermore, when an interaction terms between the $\overline{H}$ Index and a dummy variable representing a bilateral RTA is introduced (as opposed to plurilateral), the effect of the $\overline{H}$ Index in a bilateral RTA is even more pronounced (-0.309 +0.395 = 0.086 in model 7). This means that, for plurilateral RTAs, the negative value of the coefficient on the H Index suggests that there is less bilateral trade matching when there are larger size discrepancies among economies party to an RTA.

Table 1. Impact of RTAs on Grubel-Lloyd index of goods trade in Asia-Pacific (Full sample, n=5,273)

	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7)
RTA in force	-0.018** (0.008)	-0.010 (0.011)	-0.005 (0.011)	-0.003 (0.010)	-0.001 (0.010)	-0.001 (0.010)	-0.002 (0.010)
log(RTA trade)				0.036*** (0.004)	0.029*** (0.004)	0.028*** (0.004)	0.028*** (0.004)
RTA trade share					1.220*** (0.201)	1.292*** (0.203)	1.260*** (0.203)
$\bar{H}$ index						0.0616* (0.029)	-0.309** (0.111)
$\bar{H}$ index × bilateral							0.395*** (0.114)
Fixed effects	-	year	year/rta	year/rta	year/rta	year/rta	year/rta
R^2	<0.001	0.013	0.510	0.519	0.523	0.523	0.524
$\bar{R}^2$	<0.001	0.006	0.490	0.500	0.503	0.504	0.505

Table 2.Impact of RTAs on Grubel-Lloyd index of goods trade for the sub-sample of bilateral RTAs in Asia-Pacific (n=4,173)

	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(8)
RTA in force	-0.030*** (0.010)	-0.023# (0.013)	-0.011 (0.013)	-0.009 (0.013)	-0.008 (0.013)	-0.008 (0.013)	-0.007 (0.013)
log(RTA trade)				0.034*** (0.004)	0.031*** (0.004)	0.029*** (0.004)	0.032*** (0.004)
RTA trade share					0.681* (0.319)	0.805* (0.324)	1.040** (0.336)
$\bar{H}$ index						0.068* (0.032)	0.108** (0.036)
$\bar{H}$ index × RTA trade share							-2.156** (0.817)
Fixed effects	-	year	year/rta	year/rta	year/rta	year/rta	year/rta
R^2	0.002	0.015	0.488	0.497	0.497	0.498	0.499
$\bar{R}^2$	0.002	0.007	0.466	0.475	0.476	0.476	0.477

Table 3. Impact of RTAs on Grubel-Lloyd index of goods trade for the sub-sample of non-bilateral RTAs in Asia-Pacific (n=1,100)

	(1c)	(2c)	(3c)	(4c)	(5c)	(6c)	(9)
RTA in force	0.017 (0.013)	0.017 (0.016)	0.030** (0.013)	0.037** (0.013)	0.038** (0.012)	0.036** (0.012)	0.037** (0.012)
log(RTA trade)				0.072 (0.009)	-0.019 (0.010)	-0.014 (0.010)	
RTA trade share					2.848*** (0.192)	2.744*** (0.197)	2.578*** (0.154)
$\bar{H}$ index						-0.145* (0.061)	-0.162** (0.060)
Fixed effects	-	year	year/pra	year/rta	year/rta	year/rta	year/rta
R^2	0.002	0.022	0.681	0.700	0.752	0.754	0.753
$\bar{R}^2$	<0.001	-0.011	0.660	0.680	0.736	0.737	0.737

Note: ***, **, *, and # denote 0.001, 0.01, 0.05, and 0.1 level of significance, respectively. Standard errors are presented in parenthesis under the coefficients.

Table 2 takes as a subsample of the country pairs in the Asia-Pacific only those whose RTAs are bilateral (n = 4,173). The analysis for this sub-sample largely confirms findings from the overall sample. By itself, the presence of an RTA is weakly correlated with the index, but the association disappears when fixed and RTA fixed effects are introduced (models 1b – 3b). Similarly, size of total RTA trade and RTA trade share in total trade of RTA members are positively and significantly associated with the level of bilateralism (models 4b – 5b). Furthermore, the positive sign on the coefficient on the $\overline{H}$ Index suggests that the higher trade size disparity among members is also positively associated with trade matching (model 6b). However, an interaction between the H Index and RTA trade share shows that in tandem (that is, when both trade discrepancy and share of RTA trade increase) they are associated with lower level of bilateralism among RTA members (model 7).

Table 3 present the results for the subsample of plurilateral RTAs[8] (n = 1,100). This change in the sample is significant because it shows that RTA-in-force variable is positive and statistically significant for this sample when controlled for year and RTA fixed effects and other variables (models 3c-6c, 9). This means that when a plurilateral RTA is in force, trade is associated positively and significantly with higher trade matching as measured by our index. Notably, the size of the trade is not significant as an explanatory variable in any model specification (modes 4c-6c) and is hence omitted in model 9. Also notable is the effect of RTA trade share is two and half times more pronounced than in the case of bilateral RTAs. This means that non-bilateral RTAs result in more balanced trade patterns. Finally, as noted previously, larger trade size discrepancies as measured by the $\overline{H}$ Index are negatively associated with trade matching (models 6c and 9).

The repeated failure of the variable registering the existence or otherwise of an RTA between two countries to have a significant effect on the levels of bilateralism

[8] This set includes RTAs with more than two countries, such as APTA, and RTAs where one party is a country and the second party is a multi-country group, such as the agreement between Republic of Korea and the European Union.

can be elucidated by looking more closely at the effects of forming RTAs. When trade between two countries does take place at a preferential rate under an RTA, preferential rates differ among tariff items. One expects that preferences are a more important explanator of trade flows the larger the preference margin.[9] Therefore, the formation of an RTA will have a greater effect on the two countries' trade flows the greater the number of tariff items whose rates are liberalised and the larger the preference margins (*vis-à-vis* the MFN rates) on these items.

These variations in the goods subject to preferences and in preference margins across all tariff items at one time, and the changes in both of these margins over time cannot be captured in a gravity model which uses binary variables just to register whether an RTA is in force for a pair of countries or not. As Raimondi, Scoppola and Olper (2012, p. 708) observe "…the use of a dummy [to register the existence of an RTA] assumes that the magnitude of preference is the same across countries, products and years; further the dummy may capture other country specific effects."[10]

Medvedev (2010) undertook a careful empirical study of the extent of the trade between countries that are members of a bilateral or plurilateral RTA that actually takes place at preferential rates. He calculates that 32 per cent of total world trade takes place between pairs of countries that have signed an RTA. When the trade at the zero MFN tariff rate is excluded, this falls to 21.5 per cent and when a second exclusion for trade that does not use preferential rates is made the percentage falls to 15.4 per cent.[11] Hence, trade that actually takes place at preferential rates is estimated to be less than one half of total trade between RTA partners.

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[9] Furthermore, the preferential rate on a particular tariff item differs in some cases among preference-receiving countries because the rates have been fixed under different RTAs.

[10] These objections do not apply to the use of gravity models to explain bilateral trade in the market of one commodity, as in the studies by Raimondi, Scoppola and Olper (2012) and Kopp, Prehn and Brümmer (2016) of imports into the EU from Developing countries of rice and sugar respectively. In these studies, the explanatory variable relating to preferences in the gravity model is the estimated preference margin.

[11] There are several reasons for the failure to use preferential rates which are lower than MFN rates. These include low preference margins, weak supply capacities, non-compliance with the

Moreover, over the period of our dataset, RTA preference margins have been eroded as a result of the spread of RTAs themselves. Preferences do not simply relate to a preference for the preference-receiving country *vis-à-vis* all other countries. This was the case when the number of RTAs was small. However, as the number of RTAs increased rapidly and steadily after about 1990, exporting countries found that the preferences enjoyed against other countries were eroded as other countries also gained preferences in the same markets under RTAs subsequently formed with the same preference-granting country. The preference-granting country had become a hub with multiple spokes. The preferences of preference-receiving countries have been eroded as preferences which the first country enjoyed are now shared with other countries. Such preferences have become preferences *vis-à-vis* exporters only from countries that do not have a preferential access to the preference-giving country. Consequently, the preferential rate had become the new MFN rate (if all preference-receiving countries have the same preference rate) and the "MFN" rate had become the Least Favoured Nation Rate.

The extent of preference erosion due to intersecting RTAs [12] is huge. One dimension of preference erosion is the average number of countries receiving preferences in the imports of each member of the WTO. This has, for many

preferential rules of origin criteria, non-tariff barriers, weak institutional capacity to effectively administer these agreements and non-related trade conditions regarding labour standards, environment, and governance, etc. For studies in the Asia-Pacific of utilization rates, see Jha (2013); Hayakawa, Laksanpaykul and Yoshini (2016) and ESCAP (2016).

[12] Preference erosion has also come about in a second way. The second way is that the ad valorem MFN tariff rate on a good subject to preferences, or its ad valorem equivalent when imports are restricted by a non-ad valorem tariff or NTM, is reduced as a result of unilateral or multilateral action under the GATT/WTO (though there has been no round of tariff cuts since the conclusion of the Uruguay Round). This is the form of preference erosion which has received most comment in the literature, chiefly with regard to non-reciprocal preferences. Again, we know of no empirical studies of the extent to which MFN reductions in trade barriers have reduced reciprocal preferences globally. However, Raimondi, Scoppola and Olper (2012) and Kopp, Prehn and Brümmer (2016) have studied the effects of reforms of the EU's Common Agricultural Policy on non-reciprocal preferential imports from Developing Countries in the case of rice and sugar respectively. In both cases the EU slashed the intervention prices for the goods which resulted in drastic reductions in preference margins.

countries, increased rapidly as the number of spokes has increased with the formation of new RTAs. This aspect of increasing regionalism in the world economy has been examined by Medvedev (2010) and the Crawford (2016). Medvedev (2010) found that, in 2004, Members of the WTO had on average signed 5 RTAs. Crawford (2016) found that, as at December 2014, the average number of RTAs in which WTO Members participated had increased to 5.6. Moreover, she calculates that the number of RTA partners which each member had at that time, which is near the end of our sample period, was 11. The numbers for the Big Four, the four largest markets in the world economy, were as follows: EU-28 (59), the USA (20), Japan (15) and China (23). The significance of preference erosion is that, even when preferential rates are utilised, they may not give the preference-receiving country an advantage over its competitors and may, therefore, have no or little effect on bilateral trade flows.

6. Limitations

Firstly, using a binary variable relating to whether an RTA is in place does not measure the levels of discrimination in favour of the exporting countries. Regrettably, data on the preference margins applied to actual trade between two countries in any one year is not available in multi-country datasets. This is a basic shortcoming in all empirical studies of RTAs. However, the limited utilisation of preferences, low preference margins and preference erosion due to RTA proliferation, features of RTAs which are widespread in the global economy, must also be a major part of the explanation as to why the variable registering the existence or not of an RTA fails to have a significant effect on levels of bilateralism in our empirical study.

Secondly, although the applied regression model controls for time-invariant country characteristics and factors that vary over time but not across countries which might impact the Index of Bilateralism, we cannot eliminate the risk of omitted variable bias, i.e. some unobserved variable that influences the behaviour of our index is not included in the regression model. Finally, one might introduce a

lag after an RTA comes into force to reflect the phasing in of tariff concessions during the implementation period of each RTA (see Crawford (2016)).

7. Concluding remarks

The proliferation of preferential trade agreements is a central feature of the trade policy environment in the last twenty years, especially when taken in conjunction with the absence of any WTO multilateral commitments for Member countries to reduce tariffs and other barriers to trade in goods. To test the hypothesis that this proliferation of preferential trade agreements has changed the distribution of trade among countries, we have introduced a new Index of Bilateralism in trade between countries. The evidence that proliferation of preferential trade agreements has changed this distribution is very weak.

The raw series measuring the average trend in bilateralism for world trade in goods actually trends downwards for the sample period and has been roughly constant since 2005. Similarly, the series for the average level of bilateralism across all trading partners for the Big Four (figure 2), which dominate world trade, show no upward trend. The levels of bilateralism over the sample period are highest for the European Union and lowest for China, as one expects given the very large number of RTAs signed by the European Union and the small number signed by China.

We also report the series for the pairs of bilateral trade between each of the Big Four and the other three members of this group, none of which are covered by an RTA. They too show no upwards trend except for the series for trade between Japan and the EU. More pertinently, they generally show no downward trend, which might have been expected given the diversion of trade associated with the preferences which exporters from these countries were receiving outside the Big Four and the preferences that each of the Big Four were granting to imports from countries other than the fellow members of the group. The exception here is the period of decline in the levels of bilateralism for US-China trade in the period from 1987 to 2005 when trade became more unbalanced because of the large deficit in US goods trade with China.

We used the index of bilateralism between country pairs in a regression analysis of the effect of RTAs on trade flows in world in the Asia-Pacific region. After controlling for fixed effects and other factors, the regression analysis found that the bilateral RTAs in the Asia-Pacific region had an effect on the levels of bilateralism between trading partners which was negative but not significant in both groups. However, among plurilateral agreements in the Asia-Pacific region, the presence of an RTA-in-force is positively and significantly associated with increased bilateralism. With regard to other explanatory variables, the level of bilateralism is positively and significantly associated with the size of total trade of an RTA as well as with RTA trade share in total trade of RTA members. Contrary to expectations, the presence of size discrepancies in bilateral RTAs is associated positively and significantly with increased bilateralism, that is, economies of larger size differences are associated with more trade matching. In the case of plurilateral RTAs, however, this does not hold true; higher size mismatch is associated with lower level of trade matching. In short, the presence or otherwise of an RTA in force is not a major determinant of the levels of bilateralism in the panel data.

Appendix. Indexes of bilateralism

Consider the distribution by country of the goods imports and the goods exports of one country, country k, in one year. Let I_{jk} and E_{jk} denote the imports from and the exports of Country k to one other country, country j, respectively and I_k and E_k denote the total imports and exports respectively of Country k from all sources and to all destinations.

The value of matching imports/exports between the pair of countries j and k is

$$M_{jk} = (I_{jk} + E_{jk}) - | I_{Ik} - E_{jk} | = 2 \min (I_{jk} , E_{jk}) \quad (A.1)$$

This matching trade can be expressed as a proportion of the total trade between the pair of countries:

$$G_{jk} = 2 \min (I_{jk} , E_{jk}) /(I_{jk} + E_{jk}) \quad (A.2)$$

Here the symbol G indicates that the index of matching refers to goods trade. Gj_k shows the proportion of the total trade between the pair of countries which is matched. We have called this measure the Index of Bilateralism in Goods Trade between Country j and Country k. Note that, by construction, $G_{kj} = G_{jk}$

To measure the extent to which the country k's outflows and inflows with all other countries match each other, we form the Index

$$G_k = \sum_j \{2 \min (I_{jk} , E_{jk})\}/ (I_k + E_k) \quad (A.3)$$

G_k shows the proportion of the total global goods trade of the country which consists of exports to one country which are matched by imports from the same country. We have called this measure the Index of Bilateralism in Goods Trade for Country *k*.

The measure can be applied to total world trade. For the world as a whole, a global index is obtained by summing the flows over all countries. The resulting index is

$$G = \sum_k \sum_j \{2 \min (I_{jk} , E_{jk})\}/ \sum_k (I_k + E_k) \quad (A.4)$$

G is the proportion of total global goods trade that is exchanged bilaterally in the sense that the imports of one country from another are matched by exports of the other country to the first country. We have called this measure the Index of Bilateralism for Global Goods Trade.

Each of these indexes (Gj_k, G_k, and G) have the property that it lies in the unit interval [0, 1] or, if expressed in percentage terms in the interval [0, 100]. Moreover, G_k and G can each be written as a weighted mean. Equation (3) can be rewritten as

$$G_k = \sum_k Gj_k . \{(I_{jk} + E_{jk}) / \sum_k (I_{jk} + E_{jk})\} \quad (A.5)$$

That is, the measure of bilateralism for Country k is the weighted average of the measures of bilateralism with countries j, as measured by the index of bilateralism between the two countries in equation (2). The weights are the share of each country j in the total trade of Country k. In the same manner, Equation (4) can be rewritten as

$$G = \sum_k G_k . \{(I_k + E_k) / \sum_k (I_k + E_k)\} \quad (A.6)$$

That is, this global measure is the weighted average of the country measures of bilateralism in goods trade, as measured by the index of bilateralism in equation (3). Here the weights are the country shares of the total inflows plus outflows in the year concerned.

G is a simple but useful measure of the extent to which global flows of goods trade are the exchange of inflows and outflows between pairs of countries rather than outflows from a country to a second country or countries and inflows from a third country or countries.

At each level, goods trade can be broken down into its two components, bilateral trade and multilateral trade. For example, at the global level, the proportion of world flows which is multilateral is given by

$$M = \sum_k \sum_j | I_{jk} - E_{jk} | / \sum_j (I_{ijk} + E_{jk}) \quad (A.7)$$

Defined in this way, the proportions of bilateral and multilateral trade must sum to unity. Hence,

$$M = 1 - G \qquad \text{(A.8)}$$

One may use either M or G as they contain the same information.

We are also interested in the extent of bilateral trade among a group or subset of countries. One begins with the calculation of the bilateral trade of each of the countries/parties in the group with other members of the group and then divides by the total trade of the group:

$$G = \sum_{k \varepsilon S} \sum_{j \varepsilon S} 2 \min \{ I_{jk}, E_{jk} \} / \sum_{k \varepsilon S} (I_k + E_k) \qquad \text{(A.9)}$$

Here S is the subset or group of countries. One application of this measure is to assess the effects of the formation of a reciprocal trading agreement among more than two countries. A second application is to assess bilateralism among a group of countries, such as the Big Four or BRIC, which have no bilateral trade agreement between any pair in the group.

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